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Differences in intermediate outcomes for Asian and non-Asian adult hemodialysis patients in the United States

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Differences in intermediate outcomes for Asian and non-Asian adult hemodialysis patients in the United States.

Background. There is a paucity of information regarding the clinical experience of Asian hemodialysis patients. This paper describes intermediate outcomes for adult Asian hemodialysis patients compared to Caucasians and African Americans.

Methods. Dialysis facility staff abstracted clinical information on a national random sample of adult hemodialysis patients from October through December 2000. Associations of race with intermediate outcomes were tested by bivariate analyses and multivariable logistic regression modeling.

Results. A total of 429 patients were identified as Asian, 4403 as Caucasians, and 3103 as African Americans. Asian and Caucasian patients were older than African Americans [mean 63.2 (±15.6), 63.9 (±15.2), and 57.7 (±14.7) years, $P < 0.001$], and had fewer years on dialysis [mean 3.5 (±3.8), 3.1 (±3.8), and 4.1 (±4.1) years, $P < 0.001$]. Ninety three percent of Asians, 87% of Caucasians, and 84% of African Americans had a mean Kt/V ≥1.2 ($P < 0.001$). In addition, 36% of Asians, 32% of Caucasians, and 26% of African Americans had an arteriovenous (AV) fistula as their vascular access ($P < 0.001$). Hemoglobin profiles were only slightly different among the three racial groups. More Asians and African Americans had a mean serum albumin ≥4.0/3.7 g/dL compared to Caucasians (33% and 31% compared to 27%, respectively, $P < 0.001$). In the final multivariable logistic regression model, Asians were twice as likely to have a mean Kt/V ≥1.2 compared to Caucasians (the referent group) [odds ratio (OR) (95% CI) 2.10 (1.33, 3.32), $P < 0.01$]. They experienced similar intermediate outcomes for vascular access, anemia management, and serum albumin compared to the majority racial group.

Conclusion. These findings indicate that adult hemodialysis Asian patients experience similar or better intermediate outcomes compared to the majority racial group. Further study is needed to determine if these results are associated with improved survival and less morbidity in this minority group.

Key words: Asian, race, intermediate outcomes.

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In an effort to assist providers of end-stage renal disease (ESRD) services in the assessment of care provided to ESRD patients and to stimulate improvement in that care [1, 2], the Centers for Medicare & Medicaid Services (CMS's) ESRD Clinical Performance Measures (CPM) Project annually profiles certain intermediate outcomes of care for nationally representative samples of adult (≥18 years) in-center hemodialysis and adult peritoneal dialysis patients in the United States. Previous analyses have demonstrated differences in dialysis practices and intermediate outcomes for African Americans and Hispanics, as compared to the Caucasian adult hemodialysis population [3]. For instance, compared to Caucasians, African Americans were less likely to have an arteriovenous (AV) fistula and were more likely to have a delivered Kt/V <1.2, whereas both Hispanics and African Americans were more likely to have a mean serum albumin ≥4.0/3.7 g/dL [bromcresol green (BCG)/bromcresol purple (BCP) laboratory methods] [3]. This study focuses on intermediate outcomes in the adult Asian-American dialysis population.

The Asian American population is one of the fastest growing minority groups in the United States. [4] This racial group has been reported to have an increased risk of developing ESRD as compared to Caucasians. [5] In addition, Asian hemodialysis patients, in general, and Asian American patients, in particular, have been reported to have a 25% to 35% lower mortality rate as compared to their Caucasian counterparts [6, 7]. Whether or not these differences in survival rates can be accounted for by differences in dialysis practices is unclear. Identification of favorable dialysis treatment practices in this subgroup may have potential implications in the approach to treatment in other racial subgroups.

In order to examine whether dissimilarities exist in dialysis treatment practices and intermediate outcomes in the Asian population, an oversampling of adult in-center hemodialysis Asian patients was performed for the 2001 data collection. Intermediate outcomes in the

following areas were measured: adequacy of hemodialysis, anemia management, vascular access, and serum albumin. This report will describe the findings for adult hemodialysis Asian patients compared to Caucasian and African American patients in the sample.

METHODS

Study design and sample selection

Detailed information about CMS's ESRD CPM Project has previously been published [3]. In brief, in March 2001, a listing of patients who were alive and receiving in-center hemodialysis on December 31, 2000 was obtained from the 18 ESRD Network organizations (regional organizations contracted by CMS to perform quality oversight activities to ensure the appropriateness of services and protection for dialysis patients). Patients were eligible for inclusion in the sample if they were at least 18 years old as of October 1, 2000. A national random sample, stratified by the 18 ESRD Networks, was drawn. An additional number of adult Asian hemodialysis patients was then drawn (the oversample) so that a total of 500 adult Asian patients were sampled. The ESRD Core Indicators/CPM Projects had previously determined that a sample size of at least 400 was needed to provide statistically stable estimates, so 500 patients were sampled to account for some nonresponse. Clinical information was obtained on the selected patients for October through December 2000.

Data collection

In May 2001, the ESRD Networks sent a three-page data collection form to all facilities with one or more patients selected for the sample. Available patient information included gender, age, race (Caucasian, African American, Asian, Pacific Islander, Mid-East Arabian, Indian Subcontinent, American Indian/Alaska Native, Other Multiracial, and unknown), Hispanic ethnicity, the primary cause of ESRD, and years on dialysis therapy.

Patient data were abstracted from medical records by the dialysis facility staff for each month of the study period and included the patient's height, first documented pre- and postdialysis blood urea nitrogen concentration (BUN) and pre- and postdialysis patient weights, delivered dialysis session length, dialyzer code [used to determine dialyzer KUf, (ultrafiltration coefficient, a measure of fluid removal)], blood pump flow rate 60 minutes during the session the BUNs were drawn, type of vascular access, hemoglobin, prescribed weekly erythropoietin dose at the time the hemoglobin was drawn and route of administration, transferrin saturation, serum ferritin concentration, iron prescription practice, and serum albumin with the laboratory method used to determine the serum albumin, as the two commonly used methods (BCG/BCP) have been reported to yield systematically different results [8].

Completed forms were returned to the appropriate ESRD Network office where data were reviewed and entered into a computerized database [9]. The data were forwarded to CMS for aggregation and analysis.

Data analysis

To be included in the sample for analysis, a patient had to have data for at least one of the study months for paired pre- and postdialysis BUN values, hemoglobin, and serum albumin reported on the data collection form. Racial analysis was restricted to Asian, Caucasian, and African American groups due to the small numbers in other racial groups. Erythropoietin sensitivity was calculated according to the method described by Kim et al and expressed as weekly erythropoietin dose/hemoglobin/body weight in kilograms [10]. Associations of group classification with the clinical data were tested by chi-square, two-tailed Student *t* test and hierarchical analysis of variance (ANOVA) analyses. A two-tailed P value < 0.05 was considered to be significant.

Multivariable logistic regression analyses were performed separately for the following dependent variables: achieving a mean Kt/V ≥ 1.2, a mean hemoglobin ≥ 11 g/dL, use of an AV fistula, and a mean serum albumin $\geq 4.0/3.7$ g/dL (BCG/BCP). Variables entered into the initial adjusted model included race (Asian, Caucasian, or African American), gender, age, diabetes mellitus as the cause of ESRD compared to other causes combined, years on dialysis (less than 0.5 years, 0.5 to 0.9 years, 1.0 to 1.9 years, and 2 or more years—the referent category), quartile of postdialysis body mass index (BMI), type of vascular access (AV fistula or AV graft compared to the referent, catheter), mean dialysis session length, mean blood pump flow, mean Kt/V, mean hemoglobin, mean serum albumin, and ESRD Network. The Network ranked 9th for each intermediate outcome was the referent Network in the model developed for each intermediate outcome. Both forward stepwise and backward stepwise modeling techniques were employed, utilizing the likelihood ratio statistic. Due to the multiple comparisons made, only predictors with a P value < 0.01 were retained in the final adjusted models predicting the different intermediate outcomes.

The data analyses were conducted utilizing Epi Info version 6.04a (Centers for Disease Control and Prevention, Atlanta, GA, USA) and SPSS for Windows, version 10.0 (SPSS, Inc., Chicago, IL, USA) [11].

RESULTS

A total of 8853 patients were selected for the national random sample. Two hundred and forty-five patients in this national sample were identified as Asian. An additional 255 Asian patients were randomly selected to yield 500 Asian patients for the national sample. Of the

Table 1. Selected patient characteristics, by race

Characteristic	Asian *N* (%)	Caucasian *N* (%)	African American *N* (%)
Total	429 (100)	4403 (100)	3103 (100)
Gender[a]			
Male	209 (49)	2406 (55)	1526 (49)
Female	220 (51)	1995 (45)	1576 (51)
Ethnicity[a]			
Hispanic	11 (3)	797 (18)	41 (1)
Non-Hispanic	404 (94)	3399 (77)	2907 (94)
Age *years*			
Mean (±SD)[a]	63.2 (±15.6)	63.9 (±15.2)	57.7 (±14.7)
Median	66.1	66.7	58.2
Age group[a]			
18–44	61 (14)	578 (13)	620 (20)
45–54	63 (15)	628 (14)	697 (23)
55–64	78 (18)	812 (18)	742 (24)
65–74	117 (27)	1167 (27)	663 (21)
75+	110 (26)	1218 (28)	381 (12)
Postdialysis body mass index kg/m^2			
Mean (±SD)[a]	23.0 (±4.7)	26.4 (±6.3)	27.2 (±7.3)
Median	22.4	25.3	25.8
Primary cause of end-stage renal disease[a]			
Diabetes mellitus	175 (41)	1831 (42)	1192 (38)
Hypertension	121 (28)	839 (19)	1140 (37)
Glomerulonephritis	47 (11)	551 (13)	329 (11)
Other/unknown	86 (20)	1182 (27)	442 (14)
Duration of dialysis *years*			
Mean (±SD)[a]	3.5 (±3.8)	3.1 (±3.8)	4.1 (±4.1)
Median	2.1	1.9	2.9
Duration of dialysis group[a]			
<0.5	43 (10)	629 (14)	273 (9)
0.5–0.9	60 (14)	681 (16)	341 (11)
1.0–1.9	92 (22)	988 (23)	545 (18)
2.0+	231 (54)	2085 (48)	1907 (62)

Subtotals may not add up to 429 (Asian), 4403 (Caucasian) or 3103 (African American) due to missing data. Percentages may not add up to 100% due to rounding.
[a] $P < 0.001$ notes significant differences by race

9108 patients 8613 patients (95%) met the criteria for inclusion in the sample for analysis. The sample for analysis included 429 (5%) Asian, 4403 (51%) Caucasians, and 3103 (36%) African American patients. Asian patients were more prevalent in California, the Pacific Northwest, and New York, accounting for 67% of the Asians in the sample.

The Asian and African American groups had a smaller percentage of males compared to Caucasians (49% compared to 55%, $P < 0.001$). (Table 1) Asians and Caucasians were older than African Americans [mean 63.2 (±15.6) and 63.9 (±15.2) years compared to 57.7 (±14.7) years, respectively, $P < 0.001$]. Forty-one percent of Asian and 42% of Caucasian patients had diabetes mellitus as the primary cause of ESRD compared to 38% of African American patients ($P < 0.001$). Asians had an intermediate duration of dialysis therapy compared to Caucasians and African Americans [3.5 (±3.8) years compared to 3.1 (±3.8) and 4.1 (±4.1) years, respectively, $P < 0.001$]. Median (and 25th and 75th percentile) values for duration of dialysis were 1.89 (0.85 and 3.84, respectively) years for Caucasian patients, 2.11 (1.05 and 4.64, respectively) years for Asian patients, and 2.89 (1.26 and 5.56, respectively) years for African American patients. Asian patients were significantly smaller than Caucasian and African American patients, with a mean postdialysis BMI of 23.0 (±4.7) kg/m^2 compared to 26.4 (±6.3) and 27.2 (±7.3) kg/m^2, respectively ($P < 0.001$).

Adequacy of hemodialysis

Asian patients had a significantly higher mean Kt/V compared to Caucasian and African American patients [1.62 (±0.30) compared to 1.50 (±0.29) and 1.46 (±0.28), respectively, $P < 0.001$], and a higher percentage had a mean Kt/V ≥1.2 (93% compared to 87% and 84%, $P < 0.001$) (Table 2). Similar results were noted for hemodialysis adequacy as measured by urea reduction ratio. Dialysis session lengths were significantly shorter for Asian patients compared to Caucasians and African Americans [200 (±29) minutes compared to 214 (±30) and 220 (±30) minutes, respectively, $P < 0.001$]. There was no difference in the use of high-flux dialyzers (KUf ≥20 mL/mm Hg/hour) among racial groups. Mean blood pump flow rates were significantly slower for Asian patients compared to Caucasians and African Americans [372 (±62) mL/min compared to 386 (±68) and 404 (±71) mL/min, respectively, $P < 0.001$].

Table 2. Selected clinical measures of interest, by race

Clinical measure[a]	Asian	Caucasian	African American
Adequacy of dialysis			
Calculated Kt/V			
Mean (±SD)[b]	1.62 (±0.30)	1.50 (±0.29)	1.46 (±0.28)
Median	1.62	1.50	1.46
Mean Kt/V ≥ 1.2[b]	93%	87%	84%
Calculated urea reduction ratio %			
Mean (±SD)[b]	73.7 (±7.0)	71.0 (±7.1)	69.7 (±7.1)
Median	74.5	71.7	70.6
Mean urea reduction ratio ≥ 65%[b]	92%	84%	79%
Dialysis session length *minutes*			
Mean (±SD)[b]	199.5 (±29.4)	213.6 (±30.1)	219.6 (±29.5)
Median	195	210	219.7
Dialyzed with a high-flux dialyzer			
KUf ≥ 20 mL/mm Hg/hour	71%	71%	72%
Blood pump flow rate *mL/minute*			
Mean (±SD)[b]	372 (±62)	386 (±68)	404 (±71)
Median	383	400	400
Vascular access			
Type of access[c]			
Arteriovenous (AV) fistula (all patients)[b]	36%	32%	26%
AV fistula (incident patients[d])	33%	27%	26%
AV graft[b]	45%	41%	52%
Catheter[b]	19%	27%	22%
Catheter in use ≥90 days[b]	13%	18%	15%
Anemia management			
Hemoglobin *g/dL*			
Mean (±SD)[e]	11.7 (±1.1)	11.7 (±1.2)	11.6 (±1.2)
Median	11.7	11.7	11.7
Mean ≥ 11 g/dL	75%	75%	73%
Mean 11.0–12.0 g/dL[f]	38%	38%	38%
Mean 11.0–12.9 g/dL[f]	66%	64%	64%
Mean < 9 g/dL[e]	1.4%	2%	3%
Mean < 10 g/dL	7%	8%	9%
Patients prescribed erythropoietin[b]	99%	95%	96%
Within this group			
Intravenous[e]	89%	90%	92%
Subcutaneous[g]	11%	12%	9%
Erythropoietin dose units/kg/dose			
Intravenous			
Mean (±SD)[b]	89.3 (±75.8)	79.2 (±68.5)	86.2 (±73.8)
Median	69.1	60.8	65.7
Subcutaneous			
Mean (±SD)	84.3 (±66.8)	65.9 (±53.9)	68.3 (±48.0)
Median	67.0	49.9	56.0
Erythropoietin sensitivity weekly dose/hemoglobin/kg			
Intravenous			
Mean (±SD)[g]	24.0 (±24.7)	21.3 (±22.4)	23.2 (±21.6)
Median	17.7	15.7	17.3
Subcutaneous			
Mean (±SD)	21.7 (±18.3)	17.9 (±16.2)	18.5 (±14.0)
Median	17.3	13.1	14.8
Transferrin saturation %			
Mean (±SD)[b]	30.3 (±12.8)	27.7 (±12.5)	29.1 (±12.9)
Median	28.0	25.7	26.7
Mean transferrin saturation ≥20%[b]	83%	75%	79%
Serum ferritin concentration *ng/mL*			
Mean (±SD)[b]	594 (±426)	495 (±380)	564 (±403)
Median	529	428	496
Mean serum ferritin ≥100 ng/mL[b]	92%	88%	91%
Patients with relative iron deficiency[g,h]	2%	5%	4%
Patients prescribed iron[b]	61%	70%	70%
Within this group			
Intravenous	89%	92%	92%
Orally	18%	14%	15%
Serum albumin			
Bromcresol green method (BCG)			
Mean (±SD)[b]	3.82 (±0.38)	3.73 (±0.39)	3.77 (±0.38)
Median	3.87	3.77	3.80

(*Continued*)

Table 2. (Continued)

Clinical measure[a]	Asian	Caucasian	African American
Bromcresol purple method (BCP)			
Mean (±SD)[b]	3.43 (±0.45)	3.47 (±0.46)	3.63 (±0.42)
Median	3.53	3.52	3.67
Mean serum albumin ≥4.0/3.7 g/dL[b] (BCG/BCP)	33%	27%	31%
Mean serum albumin ≥3.5/3.2 g/dL[b] (BCG/BCP)	82%	78%	83%

[a] Continuous variables are displayed as the mean (±SD) and median values; categorical variables displayed as percent of available values
[b] $P < 0.001$ notes significant differences between racial groups
[c] Vascular access used on last hemodialysis session during the study period
[d] An incident patient defined as initiating in-center hemodialysis on or between January 1, 2000 and August 31, 2000
[e] $P < 0.05$ notes significant differences between racial groups
[f] Among patients prescribed erythropoietin
[g] $P < 0.01$ notes significant differences between racial groups
[h] Relative iron deficiency is defined for this report as a mean transferrin saturation <20% and a mean serum ferritin concentration <100 ng/mL

Vascular access

A significantly greater percentage of prevalent Asian patients, despite their smaller body size, were dialyzed with an AV fistula compared to Caucasians and African American patients (36% compared to 32% and 26%, respectively, $P < 0.001$) (Table 2). Among incident patients (those initiating dialysis on or between January 1, 2000 and August 31, 2000), 33% of Asians were dialyzed with an AV fistula compared to 27% of Caucasians and 26% of African Americans (NS). The use of AV grafts was intermediate for Asian patients in this sample (45% compared to 41% for Caucasians and 52% for African Americans, $P < 0.001$). Catheter use was significantly less for the Asian group, with 19% of Asian patients dialyzed with a catheter compared to 27% of Caucasians and 22% of African Americans ($P < 0.001$). A similar trend was noted for chronic catheter use (use of a catheter for 90 or more days) among the three racial groups.

Anemia management

Mean hemoglobin was slightly higher for Asian and Caucasian patients compared to African American patients [11.7 (±1.1) and 11.7 (±1.2) g/dL for Asians and Caucasians compared to 11.6 (±1.2) g/dL for African Americans, $P < 0.05$) (Table 2). Similar percentages of patients in the three racial groups attained different thresholds for mean hemoglobin.

Ninety-nine percent of Asian patients were prescribed erythropoietin, compared to 95% of Caucasians and 96% of African Americans ($P < 0.001$). The mean intravenous erythropoietin dose was significantly higher for Asian patients compared to Caucasians and African Americans [89.3 (±75.8) units/kg/dose compared to 79.2 (±68.5) and 86.2 (±73.8) units/kg/dose, $P < 0.001$]. A similar trend was noted for subcutaneous doses across racial groups. Asians demonstrated a lower erythropoietin sensitivity as suggested by the higher weekly median dose of erythropoietin required per hemoglobin unit compared to Caucasians and African Americans (intravenous 17.7 weekly dose/hemoglobin/kg compared to 15.7 and 17.3 weekly dose/hemoglobin/kg). A similar trend was noted among patients prescribed subcutaneous erythropoietin and across categories of iron status.

The mean transferrin saturation was significantly higher for Asian and African American patients compared to Caucasians [30.3% (±12.8%) and 29.1% (±12.9%) compared to 27.7% (±12.5%), respectively, $P < 0.001$]. A higher percentage of Asians had a mean serum transferrin ≥20% [83% compared to 75% (Caucasians) and 79% (African Americans), $P < 0.001$]. Similarly, mean serum ferritin concentrations were higher for Asians compared to Caucasians and African Americans [594 (±426) ng/mL compared to 495 (±380) and 564 (±403) ng/mL, respectively, $P < 0.001$]. Median (25th and 75th percentile) serum ferritin concentrations were 428 (198 and 697, respectively) ng/mL for Caucasians, 529 (248 and 842, respectively) ng/mL for Asians, and 496 (248 and 796, respectively) ng/mL for African Americans. A higher percentage of Asians and African Americans had a mean serum ferritin concentration ≥100 ng/mL compared to Caucasians (92% and 91% compared to 88%, $P < 0.001$). Only 2% of Asian patients had relative iron deficiency (defined as a mean transferrin saturation <20% and a mean serum ferritin concentration <100 ng/mL) compared to 5% of Caucasians and 4% of African Americans ($P < 0.01$).

Sixty-one percent of Asian patients were prescribed iron during the 3-month study period compared to 70% of both Caucasian and African American patients ($P < 0.001$). Within the group of patients prescribed iron, no significant differences in prescribed route of administration were noted across racial groups, with approximately 90% of patients in this subset prescribed intravenous iron.

Serum albumin

Asian patients had a higher mean serum albumin (BCG method) compared to Caucasians and African Americans [3.82 (±0.38) g/dL compared to 3.73 (±0.39) and 3.77 (±0.38) g/dL, respectively, $P < 0.001$] (Table 2). A significantly higher percentage of Asian and African American patients had a mean serum albumin ≥4.0/3.7 g/dL (BCG/BCP) compared to Caucasians (33% and 31% compared to 27%, respectively, $P < 0.001$).

Table 3. Multivariable logistic regression models for attaining selected intermediate outcomes

	Mean KtV ≥1.2	Arteriovenous fistula use	Mean hemoglobin ≥11 g/dL	Mean serum albumin ≥4.0/3.7 g/dL (bromcresol green/ bromcresol purple)
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Predictor				
Race				
Asian	2.10 (1.33, 3.32)[a]	1.20 (0.94, 1.53)	1.05 (0.82, 1.34)	NS
African American	0.49 (0.42, 0.58)[b]	0.64 (0.56, 0.72)[b]	0.86 (0.77, 0.96)[a]	NS
Caucasian, referent				
Male gender	0.17 (0.15, 0.21)[b]	1.99 (1.75, 2.26)[b]	NS	1.85 (1.66, 2.06)[b]
Age *years*	1.023 (1.018, 1.029)[b]	0.982 (0.979, 0.986)[b]	1.010 (1.007, 1.014)[b]	0.977 (0.974, 0.981)[b]
Diabetes mellitus as cause of end-stage renal disease (versus other causes combined)	0.70 (0.60, 0.82)[b]	0.74 (0.66, 0.82)[b]	NS	0.61 (0.55, 0.68)[b]
Duration of dialysis *years*				
<0.5	0.32 (0.25, 0.39)[b]	0.68 (0.55, 0.84)[b]	0.49 (0.41, 0.57)[b]	0.45 (0.36, 0.55)[b]
0.5–0.9	0.59 (0.47, 0.74)[b]	1.10 (0.93, 1.29)	1.26 (1.06, 1.49)[a]	0.65 (0.55, 0.76)[b]
1.0–1.9	0.77 (0.63, 0.95)[c]	1.20 (1.04, 1.37)[a]	1.29 (1.11, 1.49)[b]	1.02 (0.90, 1.15)
(2+ years, referent)				
Quartile post-dialysis body mass index				
Quartile 1 (lowest)	8.25 (6.42, 10.60)[b]	1.73 (1.45, 2.07)[b]	NS	NS
Quartile 2	4.90 (3.91, 6.15)[b]	1.61 (1.37, 1.90)[b]		
Quartile 3	2.44 (2.00, 2.98)[b]	1.45 (1.24, 1.70)[b]		
(highest quartile, referent)				
Vascular access				
AV fistula or AV graft	1.80 (1.50, 2.16)[b]	NE	1.27 (1.11, 1.46)[b]	1.50 (1.31, 1.71)[b]
(catheter, referent)				
Mean dialysis session length *minutes*	1.024 (1.021, 1.027)[b]	1.004 (1.002, 1.006)[b]	1.004 (1.002, 1.006)[b]	0.995 (0.993, 0.997)[b]
Mean blood pump flow *mL/minute*	1.010 (1.008, 1.011)[b]	1.0045 (1.0036, 1.0054)[b]	1.001 (1.0004, 1.002)[a]	NS
Increasing mean Kt/V	NE	0.64 (0.51, 0.81)[b]	NS	NS
Increasing mean hemoglobin *g/dL*	NS	NS	NE	1.28 (1.23, 1.34)[b]
Mean serum albumin ≥3.5/3.2 g/dL	NS	1.41 (1.22, 1.63)[b]	2.53 (2.24, 2.87)[b]	NE
Network (NW)	NS	NW 1 1.79 (1.29, 2.49)[b] NW 2 1.81 (1.31, 2.50)[b] NW 14 0.61 (0.44, 0.86)[a] NW 16 1.66 (1.20, 2.29)[a]	NS	NS

NE is not entered into the model; NS is not statistically significant.
[a] $P < 0.01$
[b] $P < 0.001$
[c] $P < 0.05$
The Network ranked 9th for each intermediate outcome was the referent Network. For arteriovenous (AV) fistula use, Network 9 was the referent.

Mutivariable analyses

After controlling for several patient characteristic and clinical variables, Asian patients were twice as likely to have a mean Kt/V ≥1.2 as Caucasians, the referent group [OR (95% CI) 2.10 (1.33, 3.32), $P < 0.01$] (Table 3). Asian patients were as likely to be dialyzed with an AV fistula, to achieve a mean hemoglobin ≥11 g/dL, and to have a mean serum albumin ≥4.0/3.7 g/dL as Caucasians, the referent group.

DISCUSSION

The Asian group is one of the fastest growing minority groups in the United States, having increased by 48% between 1990 and 2000, compared to a 13% increase in the total population over the same time period [4]. To describe and compare the dialysis experience and some intermediate outcomes for Asian hemodialysis patients to non-Asian hemodialysis patients, CMS's ESRD CPM Project included a nationally representative oversample of Asian adult hemodialysis patients in the 2001 data collection effort. In this study population, Asians were as old and as likely to have diabetes as the etiology of ESRD as compared to the Caucasian population, but were older and more likely to be diabetic as compared to the African American population. That diabetic ESRD is more common among Asians is consistent with previously reported national statistics [5], confirming that our sample population is representative of the national ESRD population.

This study's most important finding is that the Asian American hemodialysis population enjoys similar if not superior intermediate outcomes as compared to the Caucasian and African American populations. Asians had a higher mean single-pool Kt/V as compared to both Caucasian and African American patients and there were significantly more Asians who had received the minimum hemodialysis dose of Kt/V of 1.2 [12]. Furthermore,

Asian patients were as likely as Caucasian patients and more likely than African American patients to be dialyzed with an AV fistula, to have achieved the minimum recommended hemoglobin of 11 g/dL [13] and to have obtained a nutritional outcome goal of a predialysis serum albumin of 4.0 g/dL (BCG) [14]. Our finding that Asian patients have a higher mean Kt/V is consistent with a previous report that noted the mean Kt/V for Asians was higher than for the Caucasian population [7]. Based on an analysis of USRDS data from 1995 to 1997, the mean Kt/V for Asians and Caucasians was 1.30 and 1.23, respectively [15]. In our study, the superior delivered dialysis for Asians persisted and the margin of difference between Asians and Caucasians was even greater (mean Kt/V of 1.62 versus 1.5, for Asians and Caucasians, respectively). In our study, it was encouraging to note that across the three racial populations studied, the mean Kt/V was higher than the minimum recommended dialysis dose. Notably, African Americans continued to have the lowest mean Kt/V, consistent with previous reports [3].

The greater achieved dialysis dose among the Asian patients may be partly explained by the smaller weight and urea distribution volume observed in this population, given that Kt/V is inversely related to body size [16]. In our study, Asians were found to have a significantly lower postdialysis BMI as compared to Caucasian and African American patients, and patients with a low BMI were more likely to have a mean Kt/V $\geq$1.2 (Table 3). However, on multivariable analysis, Asians were found to have a twofold greater likelihood of achieving a Kt/V $\geq$1.2, even after accounting for differences in BMI. An alternative explanation may be the greater percentage of Asians who receive dialysis through an AV fistula and a greater percentage of African Americans being dialyzed through a catheter, given that vascular access type is recognized to be predictive of dialysis adequacy [17]. Primary AV fistulas are the preferred access type because of the markedly lower complication and thrombosis rate as compared to AV grafts and cuffed dialysis catheters [18]. It is also possible that racial differences in compliance with treatment time may account for variations in delivered dialysis therapy. African Americans have been found to have a higher likelihood of skipping or shortening dialysis sessions as compared to Caucasians [19]. Furthermore, this noncompliance to treatment time was determined to be a significant predictor of mortality [19]. Whether Asian Americans are less likely to skip or shorten hemodialysis sessions has not been studied. However, in an international comparison of compliance rates, Japanese patients were significantly less likely to skip dialysis treatments as compared to American dialysis patients [20].

In this study, more Asians were dialyzed with an AV fistula as compared to African Americans. Racial differences in vascular access persisted after accounting for gender, age, diabetic ESRD, and body size. A plausible explanation for this observation may be attributed to differences in timing of referral to nephrologists. The Choices for Healthy Outcomes in Caring for End-Stage Renal Disease Center Study (CHOICE Study) demonstrated that patients who were evaluated by a nephrologist four months prior to initiation of hemodialysis were more likely to have an AV fistula as their initial form of dialysis access [21]. However, an analysis of the USRDS data demonstrated that Asians had an odds ratio of 1.7 for late initiation of dialysis, as defined by a glomerular filtration rate (GFR) of $<$5 mL/min/1.73 m^2, when compared to Caucasian dialysis patients. As such, it is unlikely that early nephrology consultation and placement of AV fistula account for this finding. An alternative explanation is that Asians possess biologic differences compared to other racial groups that may account for a lower tendency for the development of thrombosis, such that the lifespan of created fistulas may be longer than that observed in other racial groups. This may then account for a higher prevalence of this form of vascular access among Asians. Reports about the prevalence of postoperative pulmonary embolism in the Chinese population cite a markedly lower rate of 2.6% [22] as compared to 9.0% in Caucasians [23]. Furthermore, Asians were found to have a lower rate of development of peripheral vascular disease as a complication of diabetes as compared to Caucasians [24]. An alternative explanation may be that Asians are overrepresented in ESRD Networks with clinicians who are more likely to practice AV fistula creations. As revealed in our multivariable analysis (Table 3), ESRD Network was a significant predictor for the insertion of AV fistulas. Furthermore, national statistics reveal that the proportion of Asians living in regions designated as Networks 2 and 16 are greater than those observed in other Networks [4].

In terms of anemia management, Asians achieved similar hemoglobin levels compared to Caucasians, but required significantly higher intravenous erythropoietin doses to maintain the same hemoglobin levels. The higher dose was required despite better iron stores among Asian patients. The reason for the apparent lower responsiveness of Asians to intravenous or subcutaneous erythropoietin is unknown. A possible reason may be related to erythropoietin or erythropoietin receptor polymorphisms across racial groups that may result in variations in responsiveness to erythropoietin. A recent report evaluating the genetic basis for gender differences in hematocrit identified that polymorphisms in the erythropoietin receptor may contribute to the lower hematocrit among females [25]. Whether similar polymorphisms in erythropoietin and its receptor may account for racial differences in erythropoietin responsiveness needs further study.

Asian patients were found to have a higher mean serum albumin as compared to Caucasian and African American patients. However, the Asian advantage did not persist after accounting for age, diabetic ESRD, and use

of an AV fistula. This suggests that the higher serum albumin levels observed in the Asian population may be accounted for by differences in demographic and clinical characteristics of the Asian as compared to the Caucasian and African American dialysis populations. Furthermore, the more common use of AV fistulas and consequent improved delivered dialysis among Asians may contribute to this finding.

The following limitations should be taken into account in the interpretation of our findings. First, the term "Asian" refers to an admixture of several races, including Oriental (Chinese and Japanese), Indian, and Southeast Asian races. Within the Asian race, marked genetic, clinical, and behavioral differences exist. For instance, recent reports suggest that renal disease risk factors vary significantly among Asian subpopulations [26]. Thus, among Asians, biologic differences are likely to exist that may also translate to differences in ESRD intermediate outcomes and long-term survival. Second, data on other relevant hemodialysis intermediate outcomes were not available in this analysis. These include differences in calcium and phosphate management, degree of control of hypertension, presence of cardiovascular and other comorbidity. Third, the slightly lower completion rate for Asian patients' forms compared to the overall sample (86% versus 95%) may have led to a selection bias, wherein Asian patients with poorer outcomes were selectively excluded. Furthermore, cultural and other behavioral characteristics that may explain the improved intermediate outcomes among Asians would need to be determined. In so doing, differences that confer clinical advantage, including diet, lifestyle, social support and degree of compliance, may be better characterized and translated into recommendations for disadvantaged dialysis populations. Finally, whether or not these observed racial differences in intermediate outcomes can account for differences in survival rates need further study. A goal of the ESRD CPM Project is to determine if there is an association between these intermediate outcomes and subsequent morbidity and mortality.

CONCLUSION

Using a large nationally representative sample of ESRD patients, we identified marked racial differences in hemodialysis practices and intermediate outcomes. As a whole, Asian American patients experienced similar, if not superior, intermediate outcomes compared to Caucasian and African American patients. Whether these differences can be accounted for by biologic or cultural reasons need further study. Regardless of the underlying reasons for the marked differences in intermediate outcomes across racial groups, our findings suggest that individualized dialysis prescriptions and monitoring of intermediate outcomes needs to be further emphasized.

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